PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 7 : H04Q 7/38

A1

(11) International Publication Number: WO 00/41426

(43) International Publication Date: 13 July 2000 (13.07.00)

(21) International Application Number: PCT/SE99/02500

(22) International Filing Date: 30 December 1999 (30.12.99)

(30) Priority Data:
09/225,223 4 January 1999 (04.01.99) US

(71) Applicant: TELEFONAKTIEBOLAGET LM ERICSSON (publ) [SE/SE]; S-126 25 Stockholm (SE).

(72) Inventors: ALMGREN, Magnus; Viktoriavägen 1, S-191 43 Sollentuna (SE). OLOFSSON, Håkan; Ringvägen 50, S-118 67 Stockholm (SE). DE VERDIER, Lisa; Nipfjällsvägen 10, 1 trp ned, S-161 33 Bromma (SE).

(74) Agent: ERICSSON RESEARCH; Ericsson Radio Systems AB, Patent Support Unit, S-164 80 Stockholm (SE).

(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).

Published

With international search report.
Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.

(54) Title: BEARER SERVICE NEGOTIATION

(57) Abstract

Techniques for matching user requirements with the ability of a bearer service are disclosed. Given at least one user requested QoS vector and at least one offered QoS vector, a resulting QoS vector is chosen for establishing a connection between a communication unit and a service provider.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece			TR	Turkey
BG	Bulgaria	HU	Hungary	ML	Mali	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MN	Mongolia	UA	Ukraine
BR	Brazil	IL	Israel	MR	Mauritania	UG	Uganda
BY	Belarus	IS	Iceland	MW	Malawi	US	United States of America
CA	Canada	IT	Italy	MX	Mexico	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NE	Niger	VN	Viet Nam
CG	Congo	KE	Kenya	NL	Netherlands	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NO	Norway	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	NZ	New Zealand		
CM	Cameroon			PL	Poland		
CN	China	KR	Republic of Korea	PT	Portugal		
CU	Cuba	KZ	Kazakstan	RO	Romania		
CZ	Czech Republic	LC	Saint Lucia	RU	Russian Federation		
DE	Germany	LI	Liechtenstein	SD	Sudan		
DK	Denmark	LK	Sri Lanka	SE	Sweden		
EE	Estonia	LR	Liberia	SG	Singapore		

BEARER SERVICE NEGOTIATION

FIELD OF THE INVENTION

This invention relates to cellular telecommunications networks and more particularly to a quality-of-service (QoS) negotiation between a communication unit and a service provider (i.e.. a bearer such as a radio network) at call set-up or at handoff.

BACKGROUND

In a typical cellular communication network, a user defines his or her service requirements to a bearer (i.e., a service provider) in terms of one or more requested quality-of-service (QoS) vectors or requested service vector, RSV. Each vector consists of a number of QoS parameters which relate to the required service. Alternatively, a user's requirements may be input into a computer or a computer application which performs the negotiation with the bearer. The QoS parameters may include, but are not limited to, required bit rate (peak, mean and/or some other rate), required bit error rate (BER) and required transmission delay. In addition, the user may also specify a price parameter for a desired service. For a given application, a range of values for each of these QoS parameters may be acceptable to the user. For example, in a web browsing application, a user normally desires a high bit rate for which the user is willing to pay a higher price. However, a user may tolerate a lower bit rate if the user is interested in minimizing the price. For some applications, the range of values for certain QoS parameters that the user is willing to accept may be relatively small. For example, in a voice application, the user may not be willing to tolerate a lower bit rate or a longer transmission delay because of the susceptibility of speech data to low bit rates and/or long delays. Under less than acceptable

conditions, e.g., low bit rate and long delay, it may be preferable that the call be blocked.

One way the user can express its service requirements to the service provider is to define two QoS vectors, wherein the QoS parameter values in the first QoS vector represent a desired service, and wherein the QoS parameter values in the second QoS vector represent an acceptable (or minium level of) service. Typically, the desired QoS parameter values indicate a lower price level sensitivity on behalf of the user, as suggested above. In contrast, the acceptable QoS parameter values are associated with a higher price level sensitivity. In the case of speech, the desired value and the acceptable value for certain QoS parameters (e.g., maximum transmission delay) may be the same, thus indicating a user's unwillingness to accept less than desired values for those QoS parameters. The at least two QoS vectors containing the desired and acceptable QoS parameter values may be expressed as:

$$QoS_{desired} = (\text{bit rate}_{maximum}, \text{delay}_{minimum}, \ldots, \text{price}_{desired})$$
$$QoS_{minimum} = (\text{bit rate}_{minimum}, \text{delay}_{maximum}, \ldots, \text{price}_{acceptable})$$

Alternatively, a user may define for the service provider a set of QoS vectors, $QoS_1 \ldots QoS_n$, wherein the combination of QoS parameter values in vector QoS_1 represent a desired service, wherein the combination of QoS parameter values in vector QoS_n represent a minimum, but acceptable service, and wherein the combination of QoS parameter values in vectors QoS_2 to QoS_{n-1} represent acceptable service that is less than the desired service but better than the minimum acceptable service. In the web browsing application, for example, each of the vectors QoS_1 to QoS_n might contain a different bit rate value. For the speech application, however, each of QoS vectors QoS_1 to QoS_n may contain the same bit rate value, once again, exemplifying that with speech data, a user is

generally less likely to accept a QoS that is less than the desired QoS. The set of QoS vectors QoS_1 to QoS_n may be expressed as:

$$QoS_1 = (\text{bit rate}_1, \text{delay}_1, \ldots, \text{price}_1)$$
$$QoS_2 = (\text{bit rate}_2, \text{delay}_2, \ldots, \text{price}_2)$$
$$QoS_3 = (\text{bit rate}_3, \text{delay}_3, \ldots, \text{price}_3)$$
$$QoS_4 = (\text{bit rate}_4, \text{delay}_4, \ldots, \text{price}_4)$$
$$\vdots$$
$$QoS_n = (\text{bit rate}_n, \text{delay}_n, \ldots, \text{price}_n)$$

At call set-up, handover and call re-negotiation, a determination has to be made as to which service will be used to establish a connection. The requirements of the user and the capability of the bearer have to be taken into account. The capability of the bearer is also expressed in the form of a QoS vector and may be referred to as an offered service vector, OSV. The procedure that attempts to match user requirements with bearer capabilities is known as a bearer service negotiation. The bearer service negotiation process results in the generation of a negotiated QoS vector or NSV. In general, a NSV contains QoS parameter values that reflect the service which the service provider is capable of providing and which satisfy requirements of the user specified values in a RSV. In the event that no match between the requirements of the user and the capability of the bearer is established, the NSV is said to be empty.

It should be noted that a service provider cannot always guarantee the quality of service defined by the NSV. In actuality, the QoS parameter values in the NSV merely represent the service which the service provider will attempt to achieve for the user at call set-up, handover or call re-negotiation. However, during the time period between the bearer service negotiation and, for example, call set-up, conditions may change due to such phenomena as data traffic fluctuation and fading, thereby making it impossible for the service provider to

achieve the level of service defined by the NSV. If the service provider cannot, in fact, achieve at least the user's minimum acceptable service requirements, the bearer service has to be renegotiated, or in the case of an on-going call, handed-over (i.e., to a different service provider) or dropped.

What is needed is an efficient and effective bearer service negotiation technique for determining whether a service provider can fulfill a user's service requirements. A method is, therefore, disclosed for enabling the system to choose a resulting or negotiated QoS vector based on user requested QoS vector and knowledge about the networks.

SUMMARY

Accordingly, the present invention provides an efficient method for matching the service requirements of a user with one or more levels of service provided by a bearer. More specifically, the present invention generates a negotiated QoS vector, NSV, which contains QoS parameter values and is one of the offered service vectors (OSVs) provided by the service provider that satisfy the user specified values of a RSV. In generating the NSV, the present invention determines the differences between the QoS parameter values contained in the one or more RSVs and the QoS parameter values contained in the one or more OSVs. In addition, each of the QoS parameter values are mapped on a comparable scale so as to assign a meaningful weight to each parameter.

In one embodiment of the present invention a method is provided for negotiating a telecommunications connection comprising the steps of: introducing a first set of quality-of-service (QoS) parameter values representing a user's desired level of service; introducing a second set of QoS parameter values representing at least one offered level of service from a service provider; comparing the QoS parameter values in the first set with corresponding QoS parameter values in the second set; selecting a level of service offered by the service provider that best satisfies the user's desired level of service based on the

step of comparing each of the QoS parameter values in the first set with at least one corresponding QoS parameter value in the second set; and establishing the telecommunications connection for the user as a function of the selected level of service offered by the service provider.

In another embodiment of the present invention a method is provided, in negotiating a telecommunication connection between a user and a bearer wherein the user specifies values for at least one of a plurality of parameters for a type of connection desired, for matching the user specified values with an ability of a bearer for satisfying the user specified values comprising the steps of: accepting values for at least one of a plurality of parameters specified by a user; comparing the user specified values with values of corresponding parameters available on said bearer; and establishing a connection between the user and a bearer that satisfies the user specified values.

In yet another embodiment of the present invention, a method is disclosed, in negotiating a telecommunication connection between a user and a bearer wherein the user specifies values for at least one of a plurality of parameters wherein the parameters form a user specified quality of service (QoS) vector, for a type of connection desired, for matching the user specified QoS parameter values with an ability of the bearer for satisfying the user specified QoS parameter values, comprising the steps of: accepting values for at least one of a plurality of QoS parameters specified by a user; comparing the user specified QoS parameter values with values of corresponding parameters available on said bearer; and establishing a connection between the user and a bearer that satisfies the user specified QoS parameter values.

BRIEF DESCRIPTION OF THE DRAWINGS

These and other objects, features and advantages of the present invention will be readily apparent to one skilled in the art from the following written description, read in conjunction with the drawings, in which:

Figure 1 illustrates a framework for bearer service negotiation according to an exemplary embodiment of the present invention;

Figure 2 illustrates a first exemplary technique for generating a negotiated QoS vector, NSV, from a plurality of offered QoS vectors, OSVs;

Figure 3 illustrates another exemplary technique for generating a NSV from a plurality of OSVs;

Figure 4 illustrates yet another exemplary techniques for generating a NSV from a plurality of requested QoS vectors, RSVs, and a plurality of OSVs; and

Figure 5 illustrates the values of an OSV failing to fulfill the RSV parameters.

DETAILED DESCRIPTION

The present invention involves an effective and efficient technique for accomplishing a service bearer negotiation between a user and a service provider (i.e., a bearer service). In general, the technique involves comparing one or more user-defined service requirements with one or more levels of service offered by a service provider and, if possible, selecting the level of service that best satisfies the user's service requirements. This may be accomplished by a three step process in which: (i) one or more requested QoS vectors, RSVs, are introduced by the user and one or more offered QoS vectors, OSVs, are introduced by the service provider respectively; (ii) the QoS parameters contained in the various QoS vectors are normalized by applying an appropriate scaling factor; and (iii) a negotiated QoS vector, NSV, is chosen from amongst the one or more OSVs, where the NSV represents the OSV that best satisfies the user's service requirements.

As an alternate way of specifying the price parameter as part of the RSV, the user may also specify a price sensitivity level parameter for a desired service. This parameter may generically be specified as high or low. For a given application, a range of values for each of these QoS parameters may be acceptable

to the user. For example, in a web browsing application, a user normally desires a high bit rate for which the user's sensitivity level to price is low. However, the user may tolerate a lower bit rate if the user's sensitivity level to price is high. With this approach to price, the QoS will contain a price sensitivity level parameter. Referring to the above described instance of desired and minimum or acceptable level of service, the sensitivity level may be low for desired service and high for minimum or acceptable level of service.

A general framework for matching a user's service requirements with a service provider's capabilities, according to exemplary embodiments of the present invention, is illustrated in Figure 1. In accordance with Figure 1, and in accordance with the first step in the three-step method of the present invention, one or more RSVs 110 are introduced to the bearer service negotiation framework 100. The bearer service negotiation framework 100 then accesses one or more OSVs 120. Within the bearer service negotiation framework 100, the one or more RSVs 110 and the one or more OSVs 120 are compared, as explained in greater detail below. The bearer service negotiation framework 100 then generates a NSV 130 if, in comparing the requirements of the user (i.e., the QoS parameter values in the RSVs 110) and the capabilities of the service provider (i.e., the QoS parameter values in the one or more OSVs 120), it is determined that the quality of service defined by the QoS parameter values in the one or more RSVs can be provided by the service provider.

In a preferred embodiment, the QoS parameters contained in each of the RSVs 110, the OSVs 120, and the NSV 130 will be the same. For example, if the RSVs 110 contain QoS parameters for bit rate and quality, then the OSVs 120 and the NSV 130 will also contain QoS parameters for bit rate and quality. Another QoS parameter that might be contained in each of the QoS vectors is a parameter representing a user's price sensitivity level. The value of this level may either be low or high. The use of this parameter within a RSV is explained above. With respect to the OSV, the significance of the price sensitivity level parameter is as

follows: If the network traffic is low or if the network is idle, the price sensitivity level within the OSV would be low. This means that the network is willing to provide a service or connection at little or no cost. Therefore, if the user's price sensitivity level is high, then a OSV with a low price sensitivity level would match this user requirement. On the other hand, the price sensitivity level within an OSV may be high. This may result from the network being busy with a high volume of traffic. In this case, a RSV with a low price sensitivity level would best match the OSV as the user does not mind paying more for the service. It should be noted, however, that if the price sensitivity level is low within an OSV, then the sensitivity level within a RSV is irrelevant. That is, if the network is willing to provide a connection at little or no cost, then it does not matter whether the user sensitivity level to price is high or low. If the level is high within an OSV on the other hand, then the user specified level has to be low to enable connection.

The OSVs 120 may be generated by a bearer service, preferably based on measurements of interference, load and gain. According to an exemplary embodiment, the OSVs 120 are generated based on long-term measurements of interference, load and gain, and in accordance with techniques that are well-known in the art. If necessary, short-term measurements may also be considered in generating OSVs 120.

In accordance with the second step in the three-step method of the present invention, the QoS parameter values contained in each of the RSVs and in each of the OSVs are scaled. This scaling may be performed on each parameter to convert the parameter to a norm such as, for example, a unitary norm. The reason for scaling is to evaluate each of the parameter values in a proper context as the parameters may not always be represented on a linear scale. One of the parameters, bit rate for example, may only be represented on a logarithmic scale. Delay, on the other hand, may be represented only on a negative scale. By normalizing the various parameters, a weight function may be assigned to one of

the parameters and another weight function may be assigned to another of the parameters.

Another reason for scaling the various QoS parameter values is that in deciding which OSV best matches the user's requirements, the appropriate amount of deference should be given to each QoS parameter. For example, if bit rate is of utmost importance to the user, as compared to the other QoS parameters, such as delay and/or signal quality, then the bit rate parameter values will be scaled, relative to the other parameter values, to reflect that importance. Thus, in comparing the desirability between two different OSVs, wherein the first OSV contains a bit rate parameter value that is just marginally better than the bit rate parameter value in the second OSV, the first OSV might be selected as being more desirable over the second OSV, during the third step of the three-step method, despite the fact that the signal quality value reflected in the second QoS vector is far superior to the signal quality value reflected in the first QoS vector.

As one skilled in the art will readily appreciate, scaling may be achieved in accordance with any number of well-known techniques. For example, a comparable scale might be maintained for each QoS parameter type (e.g., bit rate, signal quality). Then, during the second step of the three-step method, each of the various QoS parameter values contained in the RSVs and the OSVs would be mapped to the corresponding scale. By doing so, each QoS parameter value is adjusted to reflect the relative importance of the corresponding QoS parameter type. Alternatively, each QoS parameter type might be assigned a particular weighting factor. Then, during this second step, the appropriate weighting factor is applied to each QoS parameter value. However, regardless whether the former, the latter or some other alternative scaling technique is utilized, it will be understood that by scaling the various QoS parameter values, the appropriate amount of deference is given to each QoS parameter type.

In accordance with the third step in the three-step method of the present invention, the one or more RSVs 110 are compared with the one or more OSVs

120, and if, as stated above, a match is achieved between the one or more RSVs 110 and with the one or more OSVs 120, a negotiated QoS vector, NSV, 130 is generated. Of course, there are a number of different techniques that can be employed to accomplish this third step. Figures 2-4 illustrate a number of exemplary techniques for accomplishing the third step of the three-step method.

Before describing each of the exemplary techniques depicted in Figures 2-4, it should be noted that if the RSVs 110, the OSVs 120 and the NSV 130 contained N number of QoS parameters, then the graphs depicted in Figures 2-4 would have N number of dimensions. However, in order to simplify the discussion of the various techniques that can be employed to accomplish the third step in the method of the present invention, the various QoS vectors depicted in Figures 2-4 contain only two QoS parameters, for example, bit rate and signal quality. Hence, the graphs depicted in Figures 2-4 are all two-dimensional graphs.

In Figure 2, a first exemplary technique for accomplishing the third step in the three-step method of the present invention is illustrated. In the illustrated example, one RSV and two OSVs are present. The overlap area A_{RO1} between the regions defined by OSV_1 and RSV, and the overlap area A_{RO2} between the regions defined by OSV_2 and RSV are used for determining a NSV. As one skilled in the art will readily appreciate after reviewing Figure 2, the area below and to the left of OSV_1 represents a particular level of service as defined by the two QoS parameter values in OSV_1, bit rate and signal quality. Similarly, the area below and to the left of OSV_2 represents a particular level of service as defined by the two QoS parameter values in OSV_2, again, bit rate and signal quality. In contrast, the area above and to the right of RSV represents the level of service being requested by the user. Accordingly, the overlap areas A_{RO1} and A_{RO2} represent the difference between the level of service being requested by the user and the level of service being offered by the bearer as defined by OSV_1 and OSV_2 respectively.

One of skill in the art will also understand that both the level of service associated with OSV_1 and the level of service associated with OSV_2 satisfy the user's service requirements as defined by RSV. However, the level of service associated with OSV_1 is capable of providing a better bit rate than the level of service associated with OSV_2. In contrast, the level of service associated with OSV_2 is capable of providing a better signal quality than the level of service associated with OSV_1. Therefore, a determination has to be made as to whether to choose the level of service associated with OSV_1 or the level of service associated with OSV_2. In accordance with this first exemplary technique, the largest overlap area is used to determine which level of service best satisfies the user's service requirements. The overlap areas are computed by computing the product of the difference between the parameters of the RSV and each of OSV_1 and OSV_2. In this case, both OSVs satisfy the RSV, but the overlap area A_{RO2} is greater than the overlap area A_{RO1} as the difference between each of the parameters of RSV and the corresponding parameters of OSV_2 is greater than the corresponding differences between OSV_1 and RSV. The greater overlap area indicates the OSV parameters satisfying the RSV parameters by a greater margin than with the smaller overlap area. Therefore, the level of service associated with OSV_2 is determined to best satisfy the user's service requirements, and OSV_2 is, therefore, selected as the negotiated QoS vector, NSV. It should be pointed out that if an area results that is zero, no NSV is determined and the user may be blocked from establishing a connection or dropped in the case of a handoff.

Figure 3 illustrates a second exemplary technique for accomplishing the third step in the method of the present invention. In accordance with this second exemplary technique, a determination is first made as to whether the level of service associated with each of OSV_1 and OSV_2 meet the user's service requirements, that is, whether all of the QoS parameter values in each of OSV_1 and OSV_2 satisfy the QoS parameter values in the RSV. Then, considering only those OSVs that satisfy the user's requirements, the one OSV that has the longest

length is selected as the RSV, wherein the level of service associated with that one OSV is established as the level of service that best satisfies the user's service requirements.

In this case, the longest length vector represents a preference for choosing the OSV which not only satisfies the RSV but also contains one parameter which satisfies the corresponding parameter in the RSV by the greatest margin. As illustrated in Fig. 3, both OSV_1 and OSV_2 satisfy the RSV. OSV_1 satisfies the bit rate parameter of RSV by a greater margin than does OSV_2 and OSV_2 satisfies the quality parameter of RSV by a greater margin that OSV_1 does. However, OSV_1 satisfies the bit rate parameter of RSV by a greater margin than OSV_2 satisfies the quality parameter of RSV. Therefore, OSV_1 is chosen as the NSV.

It should be noted that Fig. 3 only illustrates the presence of one RSV and two OSVs. The technique described with respect to Fig. 3 may easily extend to a situation where multiple RSVs introduced and multiple OSVs are available. In this instance, each OSV is compared to one RSV and those OSVs that do not satisfy a first RSV will not be considered as candidates for being a NSV. This process may be repeated for all RSVs presented by the user.

A third exemplary technique for accomplishing the third step in the method of the present invention is illustrated in Figure 4. In accordance with this technique, the user generates two requested QoS vectors RSV_D and RSV_M, as illustrated in Figure 4, wherein the QoS parameter values contained in RSV_D represents the user's desired level of service, and wherein the QoS parameter values contained in RSV_M represent the user's minimum acceptable level of service. The bearer, for example, then generates three OSVs, OSV_0, OSV_1 and OSV_2. In determining which of OSV_1, OSV_2 or OSV_3 defines the level of service that best satisfies the user's requirements, the third exemplary technique first established whether any of OSV_1, OSV_2 or OSV_3 defines a level of service that fails to satisfy the user's minimum acceptable requirements, as defined by RSV_M. In the example illustrated in Figure 4, it will be understood that only the

level of service defined by OSV_0 fails to satisfy the user's minimum requirements. Accordingly, OSV_0 is no longer considered. Next, a determination is made as to which of OSV_1 or OSV_2 defines the level of service that best satisfies the user's desired service, as defined by RSV_D. This is accomplished by comparing the magnitude of OSV_1 with the magnitude of OSV_2, and selecting the OSV having the smallest magnitude. In the present example, the magnitude of OSV_2 (i.e., L_{RDO2}) is less than the magnitude of OSV_1 (i.e., L_{RDO1}). Accordingly, the level of service defined by OSV_2 is established as being the one that most closely matches the user's desired service requirements, as defined by RSV_D, and OSV_2 is chosen as the NSV.

Figure 5 illustrates a situation where the bearer is unable to generate any offered vectors that define a level of service which satisfy the user's requirements, as defined by RSV. As illustrated in the example of Figure 5, the bearer is only capable of providing a level of service as defined by OSV, wherein the signal quality associated with the level of service offered by the bearer satisfies the user's signal quality requirements but wherein the bit rate associated with the level of service offered by the bearer fails to satisfy the user's bit rate requirements. As the bearer is unable to offer a level of service that meets the user's service requirements, an empty NSV is generated (e.g., a QoS vector with each QoS parameter value set equal to zero, thereby indicating that the bearer was unable to offer a level of service acceptable to the user), in accordance with a preferred embodiment of the present invention. Accordingly, the user may have to submit a different RSV, i.e., one that defines a level of service that the bearer is capable of satisfying, or the user may have to negotiate with another service provider (i.e., bearer). In the event that the user is unable to negotiate an acceptable level of service with any service provider, the user may be blocked from establishing a connection or dropped in the case of a handoff.

In addition to the exemplary QoS parameters discussed above, such as bit rate and signal quality, a generic price sensitivity level may also be included as

one of the QoS parameters considered in the decision as to which level of service best satisfies the user's service requirements. The value of this parameter would indicate the user's sensitivity level for the level of service defined by the other QoS parameter values in the RSV.

The price sensitivity level may be utilized, for example, to alter the selection of the offered QoS vector, particularly when there are several offered QoS vectors which define a level of service that satisfy the user's requirements, and where the user has indicated a high sensitivity level. For instance, in the example described above with respect to Figure 2, OSV_2 was selected over OSV_1 because the level of service defined by OSV_2 exceeded the user's requirements by a greater amount than the level of service defined by the OSV_1. However, had the user indicated a high sensitivity level, OSV_1 may have been chosen as the NSV over the OSV_2.

The present invention has been described in terms of specific embodiments to facilitate understanding. The above embodiments, however, are illustrative rather than restrictive. It will be readily apparent to one skilled in the art that departures may be made from the specific embodiments shown above without departing from the central spirit and scope of the invention. Therefore, the invention should not be regarded as being limited to the above examples, but should be regarded instead as being fully commensurate in scope with the following claims.

WHAT IS CLAIMED IS:

1. A method of negotiating a telecommunications connection comprising the steps of:

introducing a first set of quality-of-service (QoS) parameter values representing a user's desired level of service;

introducing a second set of QoS parameter values representing at least one offered level of service from a service provider;

comparing the QoS parameter values in the first set with corresponding QoS parameter values in the second set;

selecting a level of service offered by the service provider that best satisfies the user's desired level of service based on the step of comparing each of the QoS parameter values in the first set with at least one corresponding QoS parameter value in the second set; and

establishing the telecommunications connection for the user as a function of the selected level of service offered by the service provider.

2. The method of claim 1 wherein each of the first set of QoS parameter values is associated with a different QoS parameter type.

3. The method of claim 2 wherein said second set of QoS parameter values comprises a plurality of subsets of QoS parameter values, and wherein each of the plurality of subsets contains a QoS parameter value for each of the QoS parameter types represented in the first set of QoS parameter values.

4. The method of claim 3 wherein said step of comparing the QoS parameter values in the first set of QoS parameter values with corresponding QoS parameter values in the second set of QoS parameter values comprises the steps of:

establishing a first graphical space as a function of the first set of QoS parameter values;

establishing a plurality of graphical spaces, wherein each of the plurality of graphical spaces is a function of the QoS parameter values in a corresponding one of the plurality of subsets of QoS parameter values;

determining a plurality of overlapping regions, wherein each of the plurality of overlapping regions represents an overlapping space between the first graphical space and a different one of the plurality of graphical spaces; and

comparing the size associated with each of the plurality of overlapping regions.

5. The method of claim 4 wherein said step of selecting a level of service offered by the service provider that best satisfies the user's desired level of service comprises the step of:

selecting a level of service offered by the service provider as a function of the size associated with each of the plurality of overlapping regions.

6. The method of claim 5 wherein said step of selecting a level of service as a function of the size associated with each of the plurality of overlapping regions comprises the step of:

selecting a level of service offered by the service provider based on the one subset of QoS parameter values which is associated with the largest of the plurality of overlapping regions.

7. The method of claim 3 wherein said step of comparing the QoS parameter values in the first set of QoS parameter values with corresponding QoS parameter values in the second set of QoS parameter values comprises the steps of

establishing a plurality of magnitudes, wherein each of the plurality of magnitudes is a function of the first set of QoS parameter values and the QoS

parameter values in a corresponding one of the plurality of subsets of QoS parameter values; and

comparing each of the plurality of magnitudes.

8. The method of claim 7 wherein said step of selecting a level of service offered by the service provider that best satisfies the user's desired level of service comprises the step of:

selecting a level of service offered by the service provider as a function of the plurality of magnitudes.

9. The method of claim 8 wherein said step of selecting a level of service as a function of the plurality of lengths comprises the step of:

selecting a level of service offered by the service provider based the one subset of QoS parameter values which is associated with the largest of the plurality of magnitudes.

10. The method of claim 3 further comprising the steps of:

determining whether the level of service associated with each of the plurality of subsets of QoS parameter values satisfy a minimum level of service desired by the user; and

identifying only those subsets of QoS parameter values that satisfy the minimum level of service desired by the user;

establishing a plurality of magnitudes, wherein each of the plurality of magnitudes is a function of the first set of QoS parameter values and the QoS parameter values in a corresponding one of the subsets of QoS parameter values that satisfy the minimum level of service desired by the user; and

comparing each of the plurality of magnitudes, wherein said step of selecting a level of service offered by the service provider comprises the step of:

selecting a level of service based on the one subset of QoS parameter values which is associated with the smallest of the plurality of magnitudes.

11. In negotiating a telecommunication connection between a user and a bearer wherein the user specifies values for at least one of a plurality of parameters for a type of connection desired and the bearer makes available at least one subset of corresponding paremeter values, said parameters forming a user specified quality of service (QoS) vector, a method of matching the user specified values with an ability of the bearer for satisfying the user specified values comprising the steps of:

accepting values for at least one of a plurality of QoS parameters specified by a user;

comparing the user specified QoS parameter values with values of corresponding parameters available on said bearer; and

establishing a connection between the user and a bearer that satisfies the user specified QoS parameter values.

12. The method of claim 11 wherein a connection to the bearer is blocked if the user specified values for each of said parameters is not satisfied by the bearer.

13. The method of claim 11 wherein the parameters comprise at least one of a bit rate, a bit error rate and a delay.

14. The method of claim 13 wherein the parameters for which a user has specified values form a requested QoS vector (RSV).

15. The method of claim 14 wherein the corresponding parameters available on a service provider form an offered QoS vector (OSV).

16. The method of claim 15 wherein the parameters representing the established connection form a negotiated QoS vector (NSV).

17. The method of claim 15 wherein values for each parameter of an OSV are derived from long term measurements.

18. The method of claim 15 wherein a connection is negotiated if the bit rate of an OSV is at least equal to the bit rate of the RSV and each of bit error rate and delay of the OSV are at most equal to the bit error rate and delay of the RSV.

19. The method of claim 15 wherein a plurality of offered QoS vectors (OSVs) satisfy the requested QoS vector (RSV).

20. The method of claim 14 wherein the user specifies a plurality of values for each of a plurality of parameters that form a plurality RSVs.

21. The method of claim 20 wherein the user specified values form two RSVs.

22. The method of claim 21 wherein the specified values for the two RSVs are desired values and acceptable values.

23. The method of claim 16 wherein an NSV is a zero vector if each of the parameters of at least one OSV does not satisfy a corresponding parameter of a RSV.

24. The method of claim 13 wherein the user specified parameters further include a price sensitivity level that is tolerated by the user.

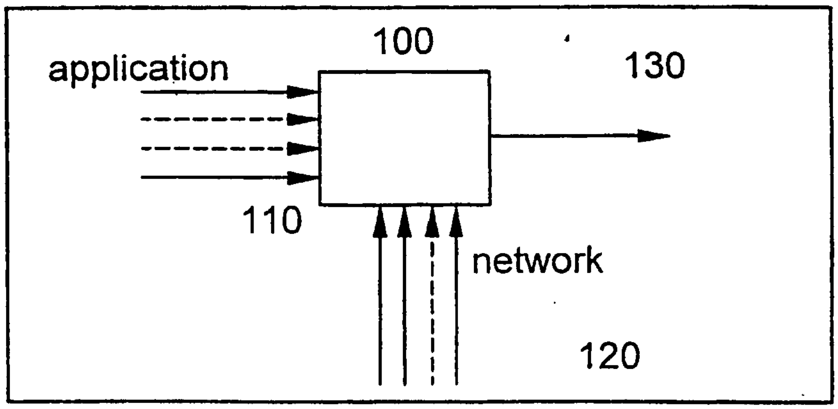

FIG. 1

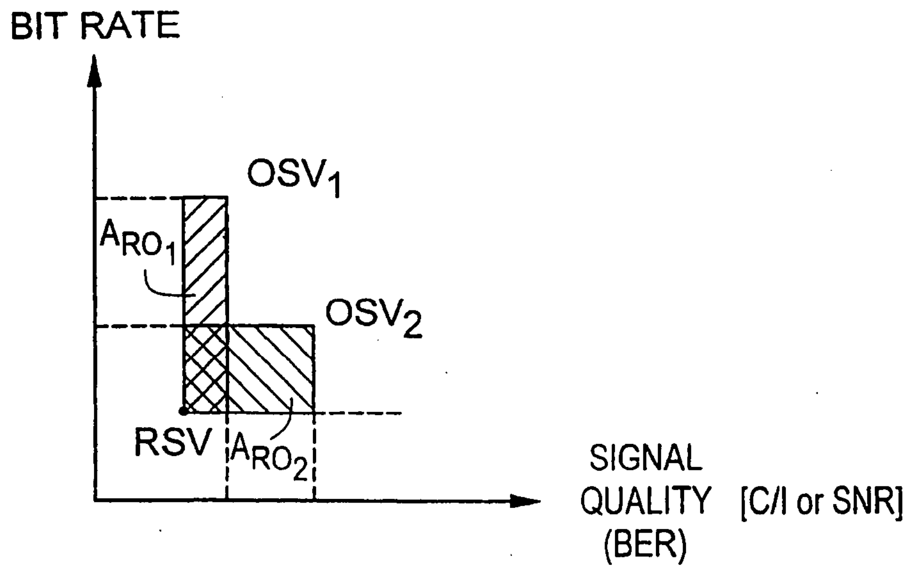
BIT RATE
OSV1
ARO1
OSV2
RSV
ARO2
SIGNAL
QUALITY [C/I or SNR]
(BER)

FIG. 2

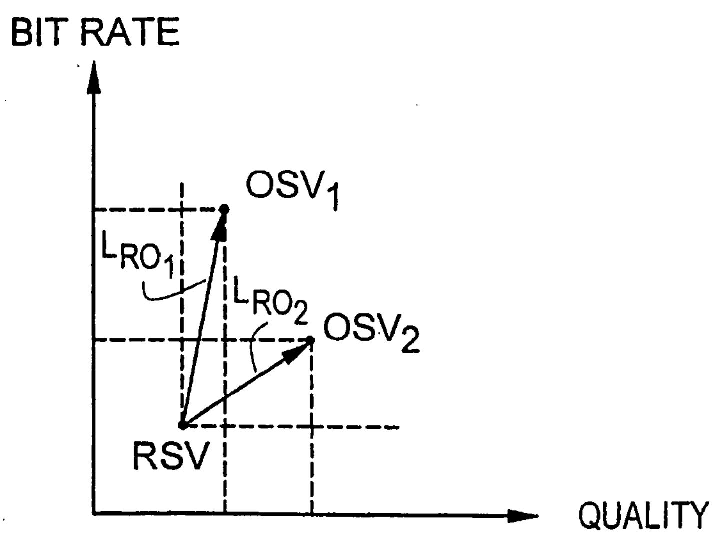
BIT RATE
OSV1
LRO1
LRO2
OSV2
RSV
QUALITY

FIG. 3

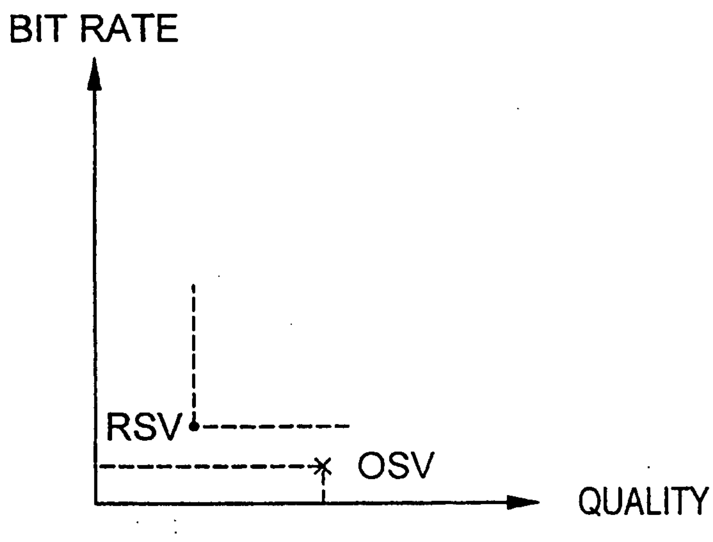
BIT RATE
RSV
OSV
QUALITY

FIG. 5

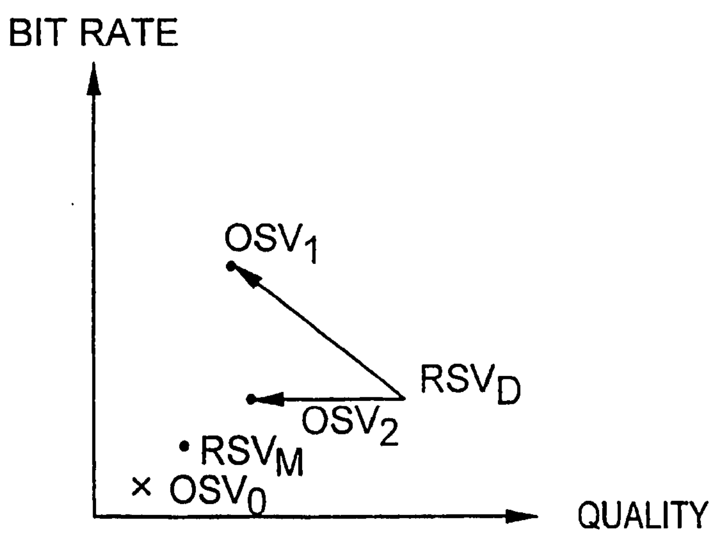
BIT RATE
OSV_1
RSV_D
OSV_2
RSV_M
OSV_0
QUALITY

FIG. 4

INTERNATIONAL SEARCH REPORT

International Application No
PCT/SE 99/02500

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 H04Q7/38

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 0 848 560 A (SIEMENS BUSINESS COMMUNICATION SYSTEMS) 17 June 1998 (1998-06-17) column 5, line 44 -column 12, line 16	1-3,7,8, 10-17, 19,24
X	WO 95 35002 A (QUALCOMM INC) 21 December 1995 (1995-12-21) page 3, line 36 -page 4, line 16 page 18, line 1 -page 22, line 39 page 7, line 36 -page 12, line 9	1-3, 11-16
X	WO 97 37457 A (ADICOM WIRELESS INC) 9 October 1997 (1997-10-09) page 7, line 9 -page 11, line 12 page 13, line 20 -page 14, line 25	1,2, 11-13
	-/--	

[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
24 May 2000	02/06/2000

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL – 2280 HV Rijswijk Tel. (+31-70) 340-2040, Tx. 31 651 epo nl, Fax: (+31-70) 340-3016	Roberti, V

1

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International Application No
PCT/SE 99/02500

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 777 986 A (GROSSMAN DANIEL B) 7 July 1998 (1998-07-07) column 7, line 37 -column 13, line 28	1,11
A	WO 97 50263 A (SCHMITT MIKAEL ;TELIA AB (SE); EMILSSON STELLAN (SE)) 31 December 1997 (1997-12-31) the whole document	1,11

1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No
PCT/SE 99/02500

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 0848560 A	17-06-1998	US 5898668 A	27-04-1999
WO 9535002 A	21-12-1995	US 5638412 A	10-06-1997
		AU 685648 B	22-01-1998
		AU 2863695 A	05-01-1996
		BR 9505489 A	20-08-1996
		CN 1129507 A	21-08-1996
		EP 0719491 A	03-07-1996
		EP 0969683 A	05-01-2000
		EP 0969684 A	05-01-2000
		FI 960195 A	15-01-1996
		JP 9502075 T	25-02-1997
		US 5818871 A	06-10-1998
WO 9737457 A	09-10-1997	US 5745480 A	28-04-1998
		AU 2547197 A	22-10-1997
		BR 9708689 A	04-01-2000
		CN 1215517 A	28-04-1999
		EP 0888674 A	07-01-1999
US 5777986 A	07-07-1998	WO 9925084 A	20-05-1999
		EP 0963630 A	15-12-1999
		AU 5245898 A	31-05-1999
WO 9750263 A	31-12-1997	EP 0906708 A	07-04-1999
		NO 985950 A	24-02-1999
		SE 9602527 A	27-12-1997